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GOVERNMENT OF INDIA
MINISTRY OF TOURISM & CIVIL AVIATION
(COMMISSION OF RAILWAY SAFETY)

RAILWAY ACCIDENT INVESTIGATION REPORT

ON

DERAILMENT

OF

L.7 DOWN LONAVLA-POONA LOCAL
BETWEEN
MALAVLI AND KAMSHET STATIONS,
CENTRAL RAILWAY,
ON
3RD MARCH, 1970

1972
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CORRIGENDUM

Page No.	Para No.	Line No.	For	Read
2	3(ii)	4	139.6	139/6
2	3(iv)	2	7	7°
3	6(iv)	1	electical	electrical
4	9(i)	1	directiou	direction
6	12(iii)	3	Th	The
6	13(ii)	1	Add 'he'after ' 138/15 '	
9	17(ii)	1	Add 'is'between 'it' and'seen'	
11	19	6	exachange	exchange.

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SUMMARY

Date	3rd March 1970.
Time	12·15 hours.
Railway	Central.
Gauge	Broad Gauge (5′-6″) —1676 mm.
Location	Km. 138/15-139/1 between Malavli and Kamshet stations.
Nature of accident	Derailment.
Trains involved	L 7 Down Lonavla-Poona Local.
Consisting of	8 coaches drawn by EA/1 Electric Locomotive No. 20011.
Speed	65-70 Km. p.h.
Operation	Absolute Block System.
Number of Tracks	Two.
Gradient	1 in 266 falling.
Alignment	Straight.
Weather	Bright and sunny.
Visibility	Good.
Casualties	1 passenger grievously injured.
Cause	Obstruction in the track due to dislodged bottom half of the gear casing. The gear casing got dislodged due to the fatigue failure of gear rim.
Responsibility	(*i*) The authority who accepted the gear rim made from incorrect material in 1953. (*ii*) Parel Workshop where the engine received P.O.H. for excessive tolerances in the driving assembly.

FROM :

The Additional Commissioner of Railway Safety,
Western Circle,
Government of India Offices,
Queen's Road,
Bombay-20.

To :

The Secretary to the Government of India,
Ministry of Tourism and Civil Aviation,
New Delhi.

(Through: Commissioner of Railway Safety, Lucknow).

SIR,

In accordance with Rule 10 of Railway Board's Notification No. 59 TTV/42/1 dated 11th April, 1966, I have the honour to report the result of my Inquiry into the derailment of L 7 Down Lonavla-Poona Local Train between Malavli and Kamshet stations on Bombay-Poona section, Bombay Division, Central Railway, at about 12·15 hours on 3-3-1970.

2. *Inspection and Inquiry*—(*i*) On 4th March 1970 accompanied by the Divisional Superintendent, Transportation Superintendent (Safety), the Deputy Chief Engineer (Track), Deputy Chief Electrical Engineer (Loco), I inspected the site of the derailment. The involved engine and coaches were examined at Lonavla on the 4th and the engine again in Kalyan Loco Shed on the 5th morning.

(*ii*) The District Magistrate, District Superintendent of Police and the Superintendent of Railway Police were informed about my inquiry. The following officers were present at the inquiry which was held on 4th and 5th March 1970 in the Assistant Engineer's office, Lonavla :—

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Shri A.C. Chatterjee	..	Divisional Superintendent, Bombay Division.
Shri F. DaCosta	..	Transportation Superintendent, (Safety), Central Railway, Bombay.
Shri R.M. Ogale	..	Dy. Chief Engineer (Track), Central Railway, Bombay.
Shri M.D. Rao	..	Dy. Chief Electrical Engineer (Loco), Central Railway, Bombay.
Shri B.G. More	..	Railway Police Sub-Inspector, Karjat.

(*iii*) A Press Notification was issued on the 4th morning inviting public who had information bearing on the accident to appear at the inquiry or to communicate with me by post.

(*iv*) Evidence of 24-witnesses has been recorded.

NOTE—(*a*) The term "front and rear", "leading and trailing", "left and right," where used are with reference to the direction of motion of L 7 Down.

(*b*) L 7 Down denotes L 7 Down Local Train from Lonavla to Poona.

3. *The Accident.*—(*i*) At about 12·15 hours on 3rd March 1970, L 7 Down was proceeding on the Down line between Malavli and Kamshet stations. It became derailed 36·6 metres ahead of Km. post 139 while travelling at about 65 to70 Km. p.h.

(*ii*) L 7 Down comprising 8 coaches was drawn by a EA/1 class electric locomotive No. 20011. As a result of the recoil the train parted at 2 places. The engine got separated from the following coaches and stopped after the accident, 35·6 metres beyond Electric structure 139·6. The first four coaches which had separated from the engine came to a stop 121 metres to the rear of the engine. The remaining 4 coaches i.e. 5th to 8th, came to a stop in the rear with a gap of 56·3 metres between the 4th and the 5th coaches.

(*iii*) The engine was not derailed.

(*iv*) The first coach behind the engine, 3520 TLR, was derailed of the rear pair of wheels of its leading bogie and all the wheels of the trailing bogie. It was standing at an angle of 7 to the track axis and was slightly tilted to the right. Its leading end was in alignment while its trailing end was slewed to the right, infringing the Up road.

(*v*) The second coach, 4231 GT, remained attached to the first coach. Its leading end was infringing the Up road while the trailing end was in alignment. It was derailed of its leading bogie and slightly inclined towards the right.

(*vi*) The third coach, 04144 GT, remained attached to the second coach. It was derailed of the trailing pair of wheels of its leading bogie. It was more or less in alignment and upright.

(*vii*) The 4th coach, 4666 GSTY, remained attached to the 3rd coach. It was derailed of the leading bogie and the rear pair of wheels of the trailing bogie. It was more or less in alignment and upright.

(*viii*) The 5th Coach, 4605 GT, separated by 56·3 metres from the 4th coach, was derailed to the right of the front bogie and the trailing pair of wheels of the rear bogie. It was slightly inclined to the right and was infringing the Up road.

(*ix*) The 6th coach, 4078 T, remained attached to the 5th coach. It was derailed of all its wheels to the right but was more or less in alignment and upright.

(*x*) The 7th coach, 04068 T, remained attached to the 6th coach. It was derailed of all its wheels to the right. This coach was also in alignment and upright.

(*xi*) The 8th coach, 3452 TLR, remained attached to the 7th coach. It was derailed of its loading bogie but was in alignment and upright.

4. *Casualty*—As a result of the accident, one passenger was thrown out of the compartment and suffered grievous injuries. No other passenger was hurt.

5. *Composition of the Train*—(*i*) L 7 Down comprised 8 bogie coaches and was hauled by EA/1 class electric locomotive No. 20011. It was fitted with a speedometer but not with a speed recorder.

(*ii*) The coaches were marshalled in the following order :—

1.	SC 3520	TLR
2.	CR 4231	GT
3.	CR 04144	GT
4.	CR 4666	GSTY
5.	CR 4605	GT
6.	CR 4078	T
7.	CR 04068	T
8.	SC 3452	TLR

(*iii*) All the coaches were wooden bodied except CR 4666 GSTY which was steel bodied.

(*iv*) The train was fully vacuum braked and all the vacuum cylinders were in working order.

(*v*) The length and the weight of the train including the engine was 192·6 metres and 343·5 tonnes respectively.

(*vi*) The seating capacity of the train was 680 and it was estimated that about 200 passengers were travelling in it at the time of the accident.

6. *Damage*—

(*i*) *Engine*, No. 20011, had its brake rigging and undergear damaged, its main driving wheel gear rim broken, bottom half of the gear housing of No. 1 main driving wheel dislodged and damaged, draw bar broken and cattle-guard bent.

(*ii*) *Coaches* :—

1st coach, SC 3520 TLR, had both the brake beams, safety brackets, leading bogie diagonals, both bolster safety brackets and trailing bogie bolster cradle bent. 1st battery box was damaged.

2nd coach, CR 4231 GT, had both the brake beams, safety brackets, leading bogie diagonal, leading bolster cradle and trailing brake beam bent. Its brake blocks were displaced.

3rd coach, CR 04144 GT, had its leading bogie cradle, trailing truss bar, trailing bolster cradle and safety bracket bent and dynamo armature broken.

4th coach, CR 4666 GSTY, had both truss bars and safety brackets bent and battery boxes damaged.

5th coach, CR 4605 GT, had its leading bogie head stock, leading bogie bolster cradle, both brake beams with safety brackets bent, left side vacuum reservoir dented and battery boxes damaged.

6th coach, CR 4078 T, had its bolster cradle slightly bent.

7th coach, CR 04068 T, had its cradle hangers bent.

8th coach, SC 3452, TLR, was not damaged.

(*iii*) *Permanent Way*—500 wooden sleepers were destroyed. 1000 keys were broken or twisted., 4 fish-plates were broken and 2 rails distorted.

(*iv*) Cost of damage to the locomotive, coaches, permanent way and electical equipment of the coaches was estimated at—

(*i*)	Locomotive	Rs.	5,000·00
(*ii*)	Coaches	Rs.	5,499·00
(*iii*)	Electrical equipment	Rs.	8,028·70
(*iv*)	Permanent Way	Rs.	24,000·00
	Total ..	Rs.	42,527·70

II. RELIEF MEASURES

7. Soon after the accident it was found that only one passenger had received injuries. He was given first aid, at the site by the guard, and then sent to the Railway hospital at Lonavla by a road vehicle, which was passing on the Bombay-Poona road near by. This passenger was given further medical attention at Lonavla and was then sent by an ambulance car to the military hospital at Poona, reaching there at 17·10 hours. He is reported to be p rogressing satisfactorily.

8. *Restoration*—(*i*) Information regarding the accident was conveyed to Malavli station by a gangman who was travelling in the train. This was followed by further informaion given by a Cabin ASM who was also travelling in the train. Both of them had to walk upto Malavli station to give this information as no field telephone was available. Malavli Station Master immediately conveyed the news to the Control office at Bombay. Break-down trains from Kalyan and Byculla and a medical van special were immediately ordered. The medical van special reached Lonavla at 16·11 hours and was returned as it was not required. The breakdown train from Kalyan reached at 16·20 hours and that from Byculla at 18·30 hours.

(*ii*) The operation of removing the infringement on the Up road was commenced at 16·50 hours and completed at 20·15 hours after which temporary single line working was introduced. The derailed coaches were rerailed at about 6·00 hours on the 4th. The track was then attended to and through running on the Down line, at restricted speed, was resumed at 11·15 hours.

(*iii*) Due to blocking of both Up and Down lines upto 20·15 hours on 3rd and Down line upto 11·15 hours on 4th, 10 Mail, Express and Passenger trains were delayed from 5 to 12 hours on the 3rd and 10 more were delayed from 1 to 7 hours on the 4th. 10 Locals and 2 Main line trains on the 3rd and 5 Locals and 3 Main line trains on the 4th had to be cancelled.

(*iv*) All passengers of L 7 Down detrained at the site and proceeded on their journey by Road transport.

III. LOCAL CONDITIONS

9. (*i*) The direction of the broad gauge double line from Malavli to Kamshet is from Northwest to Southeast.

(*ii*) The kilometrage, reckoned from Bombay VT, to various stations referred to is as under :—

Bombay V.T.		Zero
Byculla	..	4·04
Kalyan	..	53·21
Lonavla	..	127·75
Malavli	..	135·70
Site of accident	..	139·02
Kamshet	..	143·70
Poona	..	192·00

(*iii*) There are 16 to 17 electric structures per kilometre.

(*iv*) The permanent way consists of 90 RFF rails, 12·8 metres long laid on N+8 soft wood sleepers. The sleepers are provided with cast-iron anti-creep bearing plates. The tracks have been provided with 150 to 200 mm stone ballast under the sleepers.

(*v*) The maximum permissible speed of the section is 105 km. p.h. The booked speed of L 7 Down is 65 Km. p.h. There were no permanent or temporary speed restrictions in force at or near the site of the accident.

(*vi*) From Malavli upto the site of the accident the alignment is straight.

(*vii*) A down train has to negotiate the following grades between Malavli and the site of the accident :—

Malavli to Km. 135·87	Level
Km. 135·87 to 138·18	1 in 666 rising.
Km. 138·18 to 138·56	Level
Km. 138·56 to 193·45	1 in 266 falling.

(*viii*) The accident occurred on 1 in 266 falling gradient.

(*ix*) The height of the bank at the site is about 2 metres. The country side is uncultivated and undulating.

(*x*) The visibility at mid day was brilliant.

(*xi*) The headquarters of the Division is at Bombay. The Control office is also located there.

IV. TESTS AND OBSERVATIONS

10. (*i*) I inspected the engine and the coaches involved in the accident. Their disposition and the damage suffered by them has already been described.

(*ii*) The permanent way was inspected for a considerable length on either side and was found satisfactorily maintained.

(*iii*) About 15·5 metres in rear of the point of derailment a pit was noticed between the two rails. The pit was about 3·6 metres long, 1·2 metre wide and 0·5 metre deep. 5 sleepers in this portion were destroyed. Apparently this was the point at which the bottom half of the housing of the main gear dropped.

(*iv*) To the rear of this pit, spread over a distance of nearly 75 metres, were found pieces of broken 16 mm bolts. Apparently these were the bolts which were used to secure the bottom half of the gear housing to the top half.

(*v*) The coaches had received their P.O.H. on due dates and none of them was overdue.

(*vi*) The engine had received its last P.O.H. on 1-11-68. It was last inspected on 4-2-70. Since the last P.O.H. it has earned 1,12,000 kilometres. The engine repair book was examined and it was found that there were no significant repairs booked on this engine.

(*vii*) The registers maintained by the TXRs, Poona and Lonavla were also examined and it was found that there was no significant damage noted against any of the coaches.

11. *EA:1 class locomotive* : (*i*) These locomotives were manufactured by Metropolitan Vickers in 1928 and have been in service since then.

(*ii*) These locomotives are fitted with what is known as Winterthur Drive. The main features in this drive, by which the tractive force is transmitted to the wheels, can briefly be described as under :

> The torque developed by the traction motor pinions is transmitted through the intermediate gear to the main gear rim. The gear rim transmits the tractive force through the pressure plates fitted with helical springs to the end disc assembly. From the end disc assembly it is transmitted to quadrant blocks attached to the floating member. The floating member in turn transmits the force through the square slide blocks to the quill arms which are force fitted to the axle.

(*iii*) The whole drive assembly is encased by top and bottom gear housing. The top housing forms a part of the locomotive body frame. The bottom housing is supported by the top housing through 4 main assembly studs and 20-16 mm dia. bolts. The bottom housing is made of cast steel and weighs about 550 Kgs.

12. (*i*) The examination of engine No. EA/1 20011, involved in this accident, showed that the nuts of the studs holding the bottom housing to the top housing were stripped off the studs and lost. The threads of the studs did not show any damage but small metal particles sticking to the threads indicated that the nuts had been stripped off the threads and had then fallen away. The twenty 16 m.m. dia. bolts which in addition, hold the bottom housing to the top housing were sheared. Parts of 15 of these bolts were found at the site or attached to the top housing. They all showed typical tension failure. The remaining bolts could not be found even after a careful search.

(*ii*) The inside surface of the bottom housing showed severe scour marks indicating violent rubbing and exertion of excessive force on the housing.

(*iii*) The main gear rim which is 3′-9·83″ in dia. and about 1″ thick, had broken, upto the bottom of the teeth. It had got entangled with the intermediate gear and had been twisted. Th examination of the broken surface showed a progressive fatigue failure.

(*iv*) The damaged bottom half of the gear housing was found under the 5th coach about 131 metres ahead of the pit noticed in the track vide para 10 (*iii*) above.

(*v*) The various clearances of the assembly at the pressure plates, the quadrant blocks, the slide blocks, the quill arm etc. were checked and were found to be much in excess of the prescribed limits.

V. SUMMARY OF EVIDENCE

13. (*i*) P. V. Ganpule, Driver of L 7 Down stated that while proceeding at 65 to 70 Km. p.h. between Malavli and Kamshet he heard a sudden unusual noise and felt a heavy jerk while passing Km. 138/15 at about 12·15 hours. He immediately switched off the power, looked back and noticed heavy dust and ballast flying around. He also noticed that his engine had parted from the train. He, therefore, allowed the engine to roll ahead and brought to a stop near Km. 139/7. Immediately he suspected that there might be an infringement on the Up road and, therefore, deputed his assistant driver to protect the Up road. He then examined the engine and found that the gear case of traction motor 3 and 5 has fallen down. He later saw the gear case under the 5th coach. He had no trouble either with his brake power or with the engine.

(*ii*) S. M. Salve, Assistant Driver of L 7 Down stated that while passing Km. 138/15 felt a heavy lurch and heard unusual sound under the engine. Soon after the train came to a stop he was instructed by his driver to protect the Up road. According to him the speed of the train at the time of the accident was 65 to 70 Km. p.h.

(*iii*) K. V. Shukla, guard stated that at 12·15 hours while the train was proceeding from Malavli to Kamshet he received a heavy jerk at Km. 138/15 and the train stopped. As soon as the train stopped he got down and found that the train had parted in 3 portions consisting of engine at Km. 139/7, 4 coaches at Km. 139/5 and the remaining 4 coaches at Km. 139/3. He enquired about injuries to the passengers and found that only one person was injured. He gave first aid and then sent the injured accompanied by a constable to the Railway hospital at Lonavla by a road vehicle. He protected the Down road in the rear with the help of a gang man and also sent a message regarding the accident to Malavli station through a cabin ASM who was travelling on the train. The speed of the train at the time of the accident was 60 Km., p.h. and it was proceeding normally. He did not have a field telephone with him.

(*iv*) B. G. Joshi, Cabin ASM, Lonavla, stated that he was travelling in L 7 Down. After passing Malavli he received a heavy jerk and observed the ballast flying. He, therefore, pulled the alarm chain. In the meanwhile the train came to a stop. He immediately got down and not finding the guard in his compartment proceeded to the level crossing nearby where he found a gangman whom he instructed to protect the train. He then returned to the guard who told him that the Control had not been informed about the accident. Therefore, he proceeded to Malavli to give information regarding the accident to the Control. The speed of the train at the time of the accident was normal.

(*v*) Bhiva Dhondoo, a Gate-keeper at Level Crossing No. 39C at Km. 139/1-2 stated that while L 7 Down was passing by his gate he heard big crushing noise and saw the train derail and stop. He immediately protected the Up road. According to him when he heared the big noise and saw the ballast flying, the train was about 4 rails length in rear of the level crossing.

(This more or less coincides with the position of the Pit found in the track which apparently was dug by the dislodged gear case of the engine.)

(*vi*) Y. R. Mirashi, A.S.M., stated that L 7 Down left Malavli at 12·12 hours. At about 12·30 hours S.M., Kamshet informed him that L 7 Down had not reached Kamshet and that a goods train was about to leave Kamshet and that the SM, Kamshet has issued caution order to this goods train. At about 12·40 hours a gangman informed him about the derailment of L 7 Down. Immediately, on receiving the information, he informed the Section Controller at Bombay, SM, Kamshet and SM, Lonavla and asked for Breakdown Special and Medical Van. While L 7 Down was at his station, and also when it left he did not notice anything unusual with the train.

(*vii*) B.G. Shinde, TXR, Poona, stated that the rake of L 7 Down was inspected at Poona prior to its departure as L 6 Up. During the examination nothing unusual was found.

(*viii*) S.R. Thatte, TXR, Lonavla, stated that he did 'fit to run' examination of the rake before it left as L 7 Down and found no defects.

(*ix*) B. N. Dutta, CTXR, Poona, stated that the rake was last examined on pit line on 2-3-70 and whatever defects were noticed were attended to.

(The records maintained by him were examined and this was found to be correct.)

(*x*) A. C. D'Souza, Engine Examiner, Lonavla, stated that the engine was checked before it left Lonavla shed to work L 1 Down on 3-3-70 and all the bookings made by the drivers were attended to.

(The engine repair book was examined and it was found that the bookings made by the drivers had been attended to.)

(*xi*) G. S. Bhamrha, TFL, Lonavla, stated that he reached the site of accident at 16·15 hours by Kalyan Breakdown Special. He found that the driving gear was broken. The gear case was dislodged and was lying entangled under the 5th coach. He had come cross a case of gear rim breaking on a prior occasion also. He considered that the gear rims should be examined more frequently to prevent such failures.

(*xii*) R. V. Vadhavkar, Traction Foreman, Loco, VT stated that from the records maintained he found no defects giving any indication regarding the gear rim. In his opinion the gear rim failed due to fatigue which may develop after 3 to 4 lakh miles. According to him it is not possible to examine the gear rim minutely in the loco shed. He considered that frequent periodical examination of the gear rims might prevent such failures.

(*xiii*) D. V. Bhasin, Traction Foreman, Kalyan stated that the engine involved in the accident was taken for monthly inspection on 4-2-1970 and was sent out into service on 8-2-1970 after attending to the repairs. The defects noticed were all attended to and this had been recorded in the shed repairs book. According to him during the monthly inspection the inspection covers of the gear case of the main drive were being removed and the gear checked. During such inspections it was not possible to note if any crack was developing in the gear rim. According to him to minimise the risk of the gear rims breaking the main drives should be rehabilitated on top priority basis and all pinions, intergears, main drives found worn should be replaced.

(*xiv*) M. M. Dixit, PWI Telegaon, stated that the track was last inspected by him on 27-2-70 and no defects were noticed.

(Examination of his note book revealed that no defects were noticed at this mileage.)

The track was last attended to by the gang on 5th and 7th February 1970. This track according to him was not difficult to maintain.

(*xv*) P. T. Bhadhe, AEN, Lonavla, stated that at about 12·30 hours he was informed about the accident and he immediately proceeded by road, reached the site at 13·15 hours. At about 20·15 hours the infringement on the Up road was removed and single line working introduced. The derailed coaches were rerailed at 6·00 hours on 4-3-1970. The track was attended to and was certified fit for traffic at 11·15 hours. While examining the track he found nine 16 mm dia. broken bolts scattered on the track in rear of the point of derailment. He had inspected the track on 27-2-1970 by trolley and on 26-1-1970 by engine and had found nothing wrong with it at the site of the accident.

(His notes were checked and this was found to be correct).

(*xvi*) C. Christian, DEE (TRS) II, Bombay, stated that the failure of the gear rim appeared to be due to fatigue. He had given a number of causes which would induce excessive knocking in the main flexible drive and would lead to fatigue. According to him shunting operation also could induce fatigue. He considered that driving wheels of EA/1 class engines were in urgent need of rehabilitation in order to bring various clearances within the standards prescribed.

(*xvii*) M. D. Rao, Dy. CEE (Loco), stated that the failure of the gear rim was apparently due to fatigue. There had been a number of failures of the gear rims during the past 10 years and therefore, it has now been arranged that the gear rims should be checked by chalk and oil method or by magnaflux at the time of I.O.H. *i.e.*, once every 18 months to detect any incipient fatigue crack. The EA/1 class locomotives were built to a specification which called for a starting load of 450 tons up a gradient of 1 in 100. However, this has been increased to 500 tons since the second World War as it was considered that 10 per cent overload was well within the capacity of the locomotive. After examining this engine he found that there was considerable wear on the various parts and it was more than what was desirable. This he considered would accelerate fatigue but did not think specifically unsafe. The gear rims were guaranteed by the manufacturers for 2,00,000 miles but according to him this was only a commercial guarantee and he considered them safe for at least a million miles. When questioned he agreed that excessive play in various components would lead to the engine knocking, resulting in excessive load on the gear and it was, therefore, desirable to keep these clearances within the prescribed limits. According to him shunting service would induce more frequent knocking on the gear rims but this in his opinion was within the limits of the strength of the components. At present a special drive has been instituted to rehabilitate these engines and special check was being made of the gear rims to detect incipient fatigue cracks. This programme has now been proposed to be speeded up.

(*xviii*) Dr. R. N. Thakkar, AMO Lonavla, stated that he reached the site of accident at 13·35 hours. When he reached the site he was informed that there was only one injured person and he had already been sent to Railway dispensary at Lonavla. After making sure that there was no other casualty he returned to Lonavla and attended to the injured passenger. After giving necessary medical attention the injured person was sent by Municipal Ambulance car accompanied by a Doctor to the Military Hospital, Poona.

VI. DISCUSSION

14. *Time of derailment*—The driver and the guard of L 7 Down have stated that the time of the accident was 12·15 hours. According to the driver and the guard the train left Malavli at 12·11 hours. It had travelled 3·32 Kms. before it met with the accident. At the time of the accident it was travelling at 65 to 70 Km. p.h. and it would have taken about 4 minutes to reach the site of accident. Accepting that it left Malavli at 12·11 hours the accident must have occurred at 12·15 hours as stated by the driver and the guard.

15. *Speed of the train*—The driver and the Assistant Driver stated that the train was travelling at 65 to 70 Km. p.h. The guard has stated that it was travelling at about 60 Km. p.h. The booked speed of this train is 65 Km. p.h. There was no reason for the driver to reduce the speed. Taking all these into account I accept the driver's statement that the speed of the train was 65 to 70 Km. p.h.

16. *Cause of derailment*—(*i*) The evidence is absolutely clear on the following points—

1. The main driving gear rim of the trailing driving axle of Engine EA/1 20011 broke and exerted considerable thrust on the bottom half of the gear housing.
2. The bottom half of the housing of the main gear became dislodged. It was dragged forward and was found under the 5th coach.
3. The bottom gear housing showed considerable damage by having come in contact with the undergear of the coaches.
4. The inside of the bottom half of the gear housing showed scouring marks.
5. The pit noticed in the track between the two rails at Km. 139·02 indicated the place where the bottom half of the gear housing had initially dropped.
6. Broken 16 mm dia. bolts, used for securing the bottom half of the gear housing to the top half, were found scattered to the rear of the place of drop confirming that the bottom half of the gear casing fell down after these bolts had sheared.
7. The driving gear rim which failed was minutely examined by me. It was also got examined by the Chemist and Metallurgist. The examination of the fracture showed the presence of cracks running along the root of the tooth adjacent to the fracture, indicating that the fracture initiated at the root. These cracks progressed in service due to fatigue which ultimately led to the failure of this rim.

(*ii*) I have, therefore, no doubt that the main driving gear rim broke due to fatigue. After breakage the gear rim expanded and started rubbing on the inside surface of the bottom half of the gear housing and exerted enormous thrust on it. This thrust induced tension in the studs and twenty 16 m.m. diameter bolts which held it in position. This led to the stripping of the nuts of the studs and breakage of the bolts. When the bolts sheared the bottom half of the gear housing dropped. The gear housing which got dislodged was of the last axle of the engine. Therefore, it only caused slight damage to the rear cow catcher of the engine but did not derail it. The following 5 coaches rode over this dislodged gear housing and dragged it forward. This caused damage to the undergear of these coaches and the track, leading to the derailment, of these five coaches. The derailment of the 5 coaches and the damage to the Permanent Way in turn, brought about the derailment of the last 3 coaches also.

17. *Cause of the failure of the gear rim*—(*i*) This gear rim was put in service in 1953. Upto the time of the accident it had done about 13 lakh Kms. This class of engines normally receive their P.O.H. after 3,00,000 Kms. or every 3 years whichever is less. At the time of P.O.H. the gear rims are checked for incipient cracks. This engine received its P.O.H. on 1-11-1968 and upto the time of the accident it had earned 1,12,000 Kms. Apparantly at the time of P.O.H. there was no incipient crack in the gear rim, which probably developed thereafter. These engines are given I.O.H. at half the interval of the P.O.H. This engine was, therefore, not, till then, due I.O.H. In addition to the P.O.H. and I.O.H. the engines are given a monthly inspection in the loco shed at Kalyan. This monthly inspection mostly consists of check and renewal of wearing parts and electrical connections, installations, etc. During this monthly inspection the inspection cover of the main drive gear boxes are removed and the gears are checked with hand for any broken parts or any foreign matter and also the teeth are examined for damage. During this inspection, however. if a fatigue crack is developing it is not possible to detect it. Evidently the fatigue crack which led to this failure could not be detected during the monthly inspection.

(*ii*) From the records it seen that this rim failed after 13,00,000 kilometres after being put into service. It has done 1,12,000 kilometres since the last P.O.H. when it was checked for incipient cracks—rather low kilometrage. The causes which led to the fatigue in this rim, therefore, have to be examined.

(*iii*) This gear rim was imported in 1953. The broken gear rim was analysed and it was found to be made of class III steel which was not according to specifications. However, a number of gear rims were imported at the same time and they are still in use and are giving satisfactory service. It is not possible at this distant date to assign any reason as to how a gear rim manufactured out of material not according to specifications, was accepted and to fix responsibility for it. Apparently, however, the use of incorrect material accelerated fatigue in this case.

(*iv*) Among others the causes, which induce overstress leading to fatigue in the gear rim, are excessive wear at the following locations—

(1) Worn main quill drive bearings.
(2) Slack bronze liners of the main drive.
(3) Weak pressure springs of the main drives.
(4) Wear of the pressure plate seatings in the end discs of the main drive.
(5) Worn white metal lining of quadrant and sliding blocks.
(6) Worn main driving arm spherical ends.
(7) Worn spherical seating of quadrant blocks.

The examination showed that excessive wear at all these points was there in this particular assembly to a more or less pronounced degree. This was further corroborated by the fact that the teeth in general revealed evidence of flaking off of thin bright layers of metal due to the battering or rubbing on their mating surface. Further, the tip of the teeth showed blueing at places confirming batterring or rubbing they had received.

(*v*) In addition to these when an engine is put to shunting service it is subjected to more frequent and abrupt change of load subjecting the gear rims to repeated strain. This engine had been used both for main line as well as shunting service.

(*vi*) These engines were designed to a specification which called for the starting of the train with 450 tons up a gradient of 1 in 100. The load that is put on these engines is at present 500 tons, an increase of about 10 per cent over the designed load. This too, when the engines have become more than 40 years old, must have induced overstresses in the gear rim. It is therefore evident that the failure of this gear rim by fatigue was due to the low grade material out of which it was manufactured and the excessive stresses induced in it on account of—

(1) Excessive play in various components of the driving assembly,
(2) about 10 per cent excess load put on this engine, and
(3) the mixed service to which it was put.

18. *Responsibility for the failure of the rim*—(*i*) It was expected that these EA Class engines would be replaced by 1970 as they have already done over 40 years of service and are considered to have spent their useful life. However, these expectations have not been fulfilled, and it is likely that they will remain in service for a few years more. Since these engines have to remain in service, all the tolerances of the driving gear have to be brought within the specified limits during the P.O.H. This engine had received its P.O.H. on 1-11-1968. Examination of the engine however, revealed that the wear on various components of the driving assembly was grossly in excess of the tolerances specified. No doubt the material out of which the rim was manufactured was of a lower grade. These engines have done a long service and therefore need very careful attention during the P.O.H. Parel Workshops have been building up wear on pressure plates and other important components but have not been bringing various tolerances of the driving assembly within the specified limits as this would have meant heavy rehabilitation. Notwithstanding the fact that heavy rehabilitation would have been necessary, the failure to bring the tolerances within the specified limits certainly accelerated the fatigue failure of this gear rim made out of low grade material. The responsibility for this, therefore, must lie with Parel Loco Workshops where the engine received its P.O.H., though it is not possible to assign individual responsibility.

(*ii*) A certain amount of responsibility must devolve on whoever accepted the rim made out of inferior steel instead of steel as specified. It is not possible for lack of records to apportion this responsibility.

19. *Remedial Measures*—There have been 14 cases of failure of gear rims in service. In addition to these, 19 defective gear rims were detected during the shop examination. Since these engines have to remain in service for a few years more, it has been decided by the Railway Administration to rehabilitate the driving wheels of these engines by attending to the gear assembly thoroughly and by replacing the gear rims wherever necessary. It is noted that foreign exachange for the import of gear rims has been released and orders will be placed shortly. At present the rehabilitation programme is 3 wheel sets per month. This, in view of the recent accident, is being stepped up and it is expected that the driving wheels of all the engines will be rehabilitated in the next 12 months.

VII. CONCLUSIONS AND REMARKS

20. *Cause of the Accident*—On full consideration of circumstantial and oral evidence and tests carried out, I have reached the conclusions stated below—

(*i*) The derailment of L. 7 Down Lonavla-Poona Local was due to the obstruction caused by the dislodged bottom half of the gear casing of one of the driving axles of Engine No. EA/1 20011.

(*iii*) The gear casing got dislodged due to breakage of the gear.

(*iii*) The gear rim broke due to fatigue during service.

21. *Responsiblity*—The breakage of the gear rim due to fatigue has apparently been accelerated by the use of incorrect material and excessive clearances in various vital components of the driving assembly. The responsibility for the excessive clearances lies with the Parel Workshop where the engine had received its P.O.H. Individual responsibility, however, cannot be assigned.

22. *Remarks*—(*i*) The gear rims of the driving wheels of all the engines of EA/1 Class should be subjected to a crack-detection examination on an urgent basis and the rims in which fatigue cracks might have started should be replaced at once.

(*ii*) These gear rims should be examined for cracks during I.O.H. in addition to the examination now being done during P.O.H.

(*iii*) Safety chains should be provided on the gear housing of EA/1 locomotives to prevent the gear case from dropping even if the gear rim gives way. This should be taken in hand on top priority and completed in next two months.

(*iv*) The programme of rehabilitation of the driving wheels of EA/1 locomotives should be expedited by stepping up the rate of out-turn.

(*v*) Lomotives whose gear rims have done a large mileage and the general condition of whose driving assembly is not in good condition should be earmarked for shunting. Other locomotives of this class should not normally be used for shunting duty.

(*vi*) An organisation should be set up to ensure that various clearances of the traction gear, including traction motors, are brought strictly within specified limits during P.O.H.

Yours faithfully,

(Sd.) (C. R. SULE)
Additional Commissioner of Railway Safety, Western Circle
Bombay.

BOMBAY:
Dated 30th May, 1970.

Railway Board have remarked as under on the Recommendations contained in para 22 of the Report

1. *Para. 22 (1) of the Report* : Necessary action has been taken by the Railway Administration in this regard.

2. *Para. 22 (ii) of the Report* : This has been accepted by the Railway for implementation.

3. *Paras. 22 (iii) & (iv) of the Report* : The Railway is being asked to complete the work on top priority basis.

4. *Para. 22(v) of the Report* : In view of the position explained by the General Manager, no further action is required.

5. *Para 22 (vi) of the Report* : Necessary action has been taken by the Railway in this regard.

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